Integrity ★ Service ★ Excellence

Complex Materials and Devices

07 MAR 2013

Dr. Hugh C. De Long
Division Chief
AFOSR/RTD
Air Force Research Laboratory

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
07 MAR 2013		**00-00-2013 to 00-00-2013**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Complex Materials and Devices	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Air Force Office of Scientific Research ,AFOSR/RTD,875 N. Randolph,Arlington,VA,22203**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
Presented at the AFOSR Spring Review 2013, 4-8 March, Arlington, VA.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**7**	

Scientific Opportunities: Both bottom up & top down approaches

Focus on 10-20-year time horizon

- **ASD(R&E) "Six Disruptive Basic Research Areas"**
  - Metamaterials and Plasmonics
  - Quantum Information Science
  - Cognitive Neuroscience
  - Nanoscience and Nanoengineering
  - Synthestic Biology
  - Computational Models of Human Behavior

Technology Horizons 2010-2030

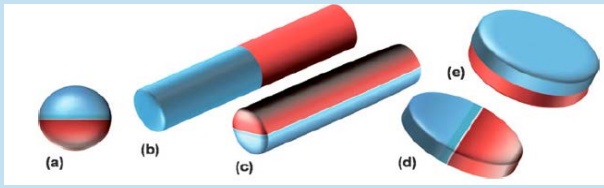
- Tech Horizons Grand Challenges:
  - Inherently Intrusion-Resistant Cyber Networks
  - Trusted Highly-Autonomous Decision-Making Systems
  - Fractionated, Composable, Survivable Remote-Piloted Systems
  - Hyper-Precision Air Delivery in Difficult Environments

RTD Current Scientific Goals

Complex Materials and Structures

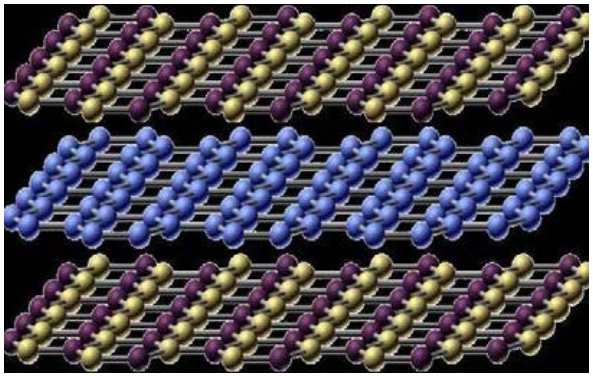
- Focused on future materials and structures
- Change functionality or performance characteristics
- Exploit the interaction between the environment and the material interface
- New materials of complex design and function

Janus Nano-Particles



Complex Electronics and Fundamental Quantum Processes

- Complex engineered materials and devices
- Devices based on quantum phenomena
- Integration into new classes of devices

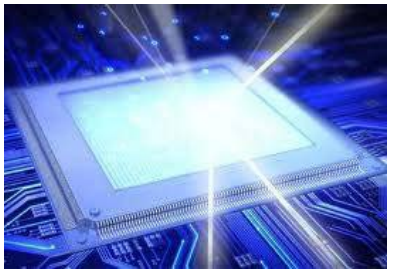


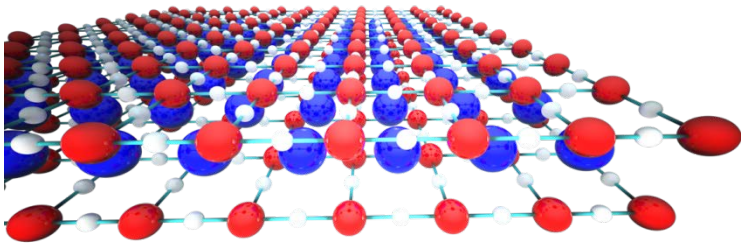
Optics, Electromagnetics, Communication, and Signal Processing

- Adaptive optics and optical imaging
- Lasers and nonlinear optics
- Distributed multilayered sensing

Natural Materials and Systems

- Using, mimicking, or altering ways that natural systems build materials and sensors and perform under extreme conditions.

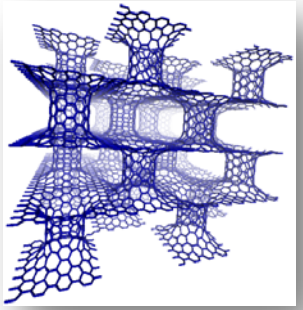


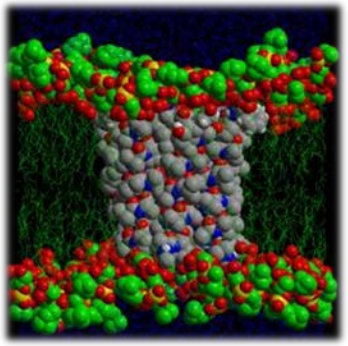


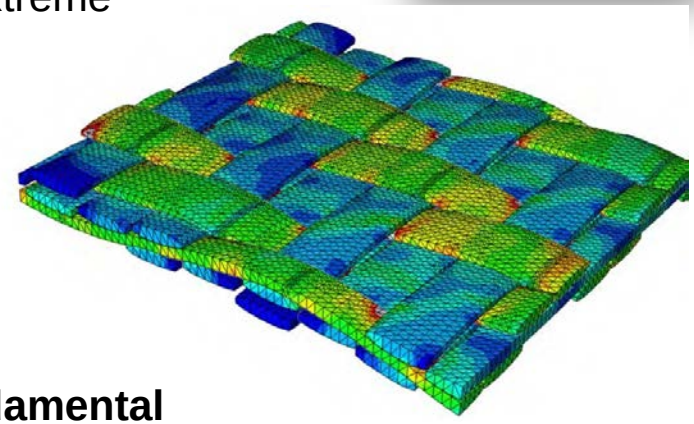
RTD Technical Programs

Complex Materials and Structures

- Organic Materials Chemistry (Lee, C)
- Low Density Materials (Harrison)
- Mechanics of Multifunctional Materials and Microsystems (Lee, B)
- Aerospace Materials for Extreme Environments (Sayir)







Complex electronics and fundamental quantum processes

- Quantum Electronic Solids (Weinstock)
- Photonics and Optoelectronics (Pomrenke)
- GHz-THz Electronics (Hwang)

Natural Materials and Systems

- Natural Materials and Systems (DeLong)

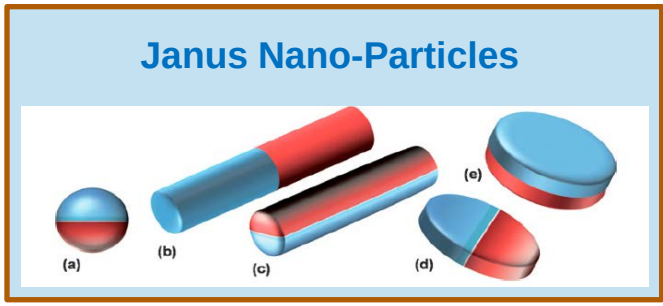
RTD Future Strategic Direction

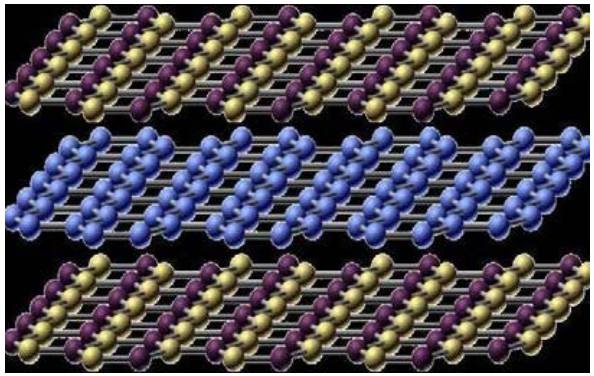
Structural and Functional Materials

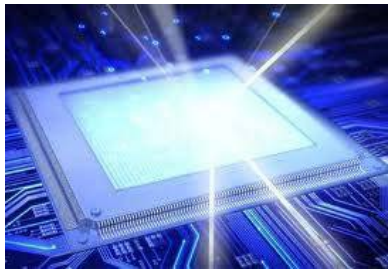
- Focus on complex materials, microsystems and structures
- Hierarchical design of mechanical and functional properties
- Dynamic functionality and/or performance
- Studying, using, altering or mimicking of biomaterials
- Understanding the natural of the biotic/abiotic interface

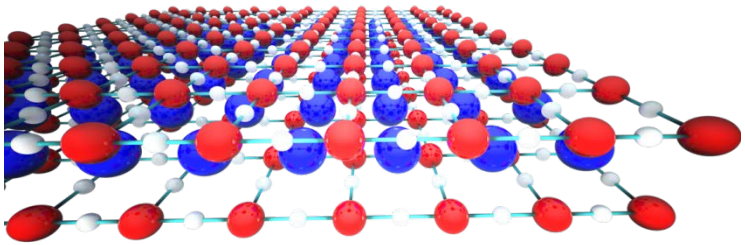
Devices and Systems

- Integration into new classes of devices
- Fundamental understanding of materials that are not amenable to conventional computational means.
- Exploration and understanding of a wide range of complex engineered systems and devices
- Mimicking of existing natural sensory systems









New Directions

(Cross-Directorate /Cross-DoD/Cross-Agencies/International Collaborations)

BRI Topics (FYs 12, 13 & 14)

- Active, Functional Nanoscale Oxides (Weinstock)
- Bionanocombinatorics (DeLong, Hearn)
- Origami Design for the Integration of Self-Assembling Systems (Harrison, Stargel, Smith, Fahroo)

- Autonomic Material Systems Utilizing Biomolecular Transduction (Lee B, DeLong)
- Layered Structured 2D-Materials (Sayir)
- Pulse Laser Processing of Materials (Parra, Harrison)
- Sustainable Alloy Design - Rare Earth Metals (Sayir, Fuller)

- Bio-Sensing of Magnetic Fields (Larkin, Bradshaw, Curcic, DeLong
- 2D Materials & Devices Beyond Graphene (Hwang, Pomrenke, Harrison, Mah)
- Nanoscale Building Blocks for Novel Materials (Berman, DeLong)
- Theory-based engineering of biomolecular circuits (Fahroo, DeLong)
- Metal Dielectric Interface (Sayir, Luginsland)

QUESTIONS?